

New Mexico-Chihuahua Partnership for Innovation

The New Mexico-Chihuahua Partnership for Innovation (NMCPFI) brings together New Mexico State University (NMSU), New Mexico Institute of Mining and Technology (NMT), Universidad Autonoma de Cd. Juarez (UACJ), Tecnológico de Monterrey-Chihuahua (ITESM), the Chihuahua Trade Office (CTO), the New Mexico Economic Development Department (NMEDD), Los Alamos and Sandia National Laboratories (LANL and SNL), the Mesilla Valley Economic Development Alliance (MVEDA), the Centro de Investigación en Materiales Avanzados (CIMAV), Centro de Investigación en Alimentación y Desarrollo (CIAD), and high tech associations and consortia and private business to develop the infrastructure for more effective commercialization of emerging research. The 2-year project will significantly advance knowledge of and collaboration on technology transfer and management in a region full of potential, but currently lacking a coordinated means for sharing promising technologies with potential entrepreneurs and for supporting university researchers through the entire process of technology development and establishment of a successful start-up. The proposed project will (1) through joint programs of U.S. and Mexican partner institutions, provide educational experiences for researchers, technology managers, and entrepreneurs that will enable them to integrate technology development and commercialization in an international environment and to establish start-up companies that respond to regional needs and are sustainable; (2) create a bi-national regional network of those involved in technology creation, commercialization, and use; and (3) spur economic development in a region characterized by high levels of poverty.

Need

The New Economy presents many challenges and opportunities for states. Despite its past and present intellectual infrastructure, including three Carnegie Research Extensive universities and two National Laboratories, New Mexico is not achieving its potential. According to the 2002 State New Economy Index, (Atkinson, 2002), New Mexico is 27th out of 50 states, dropping from its 1999 ranking of 19th. The state is bountiful in intellectual capital, boasting the highest ratio of PhDs per capita in the nation, but lacks financial capital. New Mexico must relearn the lessons of adding value through technology development and commercialization, or high technology business and industry will continue to locate elsewhere and the graduates of New Mexico's research universities will follow (in southern New Mexico, 90% of graduates leave the area after graduation).

New Mexico, with a population of 1,829,146, is home to a minority-majority population. Of the total population, 42.1% are persons of Hispanic or Latino origin, 9.5% are American Indian, 1.9 % are African American, 1.1% are Asian, 3.6% are of two or more races, and 44.7% are White, not of Hispanic or Latino origin (2000 Census of Population and Housing). The percentage of persons below the poverty line is 18.4% compared to 12.4% nationally. Both New Mexico State University and the University of New Mexico are designated as Hispanic-Serving Institutions.

Within the last few years, a new border crossing in Santa Teresa, at the southern end of Doña Ana County has provided new opportunities to interact with Mexico. Yet, according to a 2002 report on business incubation in the Mesilla Valley (NMSU Center for Entrepreneurship), little has been done to capitalize on these opportunities for the good of the community. The maquiladora industry (the backbone of economic development in the last decade) in Ciudad Juarez and Chihuahua is declining. In Ciudad Juarez, maquiladora employment fell by 21,000 and employment in the manufacturing sector fell by 35,000 between 2000 and 2001 (UTEP, 2002). In Chihuahua, the decline in maquiladora employment in the same period was 8,000, with a similar loss in manufacturing employment. New Mexican communities near the border with Mexico had hoped to attract suppliers to the maquiladora industries. Now it appears evident that economic development will need to depend on innovation and high tech expansion as the maquiladora move to sites in Asia with less expensive labor.

Due in part to a struggling global economy and to increased security along the U.S.-Mexico border, New Mexico exports to Mexico declined 11.77% from 2000 to 2001 (NMEDD, 2004). Realizing the need to increase economic development in and trade between New Mexico and the state of

Chihuahua, the Governors of New Mexico and Chihuahua have established the New Mexico-Chihuahua Commission. Specifically, the Commission is charged with increasing trade and tourism, helping to “jump-start” business, and creating jobs along the border. A central goal of the initiative is to put New Mexico products on Chihuahua store shelves and vice-versa.

An additional complicating factor in the commercialization of technology from universities in New Mexico and Chihuahua is the lack of a coordinated infrastructure for helping develop scientists, engineers, and entrepreneurs who have an understanding of how to take technology from the laboratory to the marketplace. The NMCPFI will focus on developing technology professionals in the second two years of their undergraduate careers and provide the structure for them to collaboratively develop technological solutions to regional problems that demonstrate strong potential for sustainability. Through a sustained and coordinated effort, the project will take research developed in the partner institutions, with an early focus on feasibility and the realities of border business development, to the commercialization stage.

Project Goals

The proposed project will support the federal, state, and multi-national initiatives to improve economic development in the U.S.-Mexico border region through collaboration of the partner institutions in cooperation with economic development forces and the high technology sector in the New Mexico and Chihuahua. Specifically, the goals of the New Mexico-Chihuahua Partnership include:

- Creating cross-functional design teams of undergraduate students, with advisors from the faculty and partner organizations and businesses, to develop technology solutions to regional needs that can be commercialized
- Forming start-up companies based on the technologies developed that demonstrate both a solution to a regional need and sustainability
- Establishing an electronic, bilingual Alliance for Technology network, including an electronic, bilingual newsletter, to promote communication, technology partnering, and technology development and commercialization
- Recruiting low-income minority students to participate in project activities (in New Mexico, primarily female, Hispanic, and Native American students; in Mexico, primarily indigenous students and females)
- Identifying and supporting student internship positions with interested technology businesses and organizations
- Integrating technology development, management, commercialization, and marketing into courses and experiences for science, engineering, and business students at the partnership institutions
- Sponsoring an annual showcase of student/faculty projects for an audience representing business, industry, and economic development interests in New Mexico and Chihuahua

The proposed project responds to the PFI program’s goals of (1) stimulating transformation of knowledge created by the national research and education enterprise into innovations that create new wealth, build strong local, regional and national economies and improve the national well-being; (2) broadening the participation of all types of academic institutions and all citizens to more fully meet the broad workforce needs of the national innovation enterprise; and (3) catalyzing the enabling infrastructure necessary to foster and sustain innovation. By capitalizing on the shared interests of the partner institutions of higher education, local and state economic development agencies, technology consortia, private business, and National Laboratories, the proposed project will advance technology transfer and commercialization related to regional needs, information sharing, small business start ups, and preparation of minority scientists, engineers, and entrepreneurs with an understanding of technology development and commercialization in a bi-national context..

Implementation Plan

Goal 1. Cross-functional design teams. To spur economic development in the New Mexico-Chihuahua border region, all partners must work together to prepare young scientists, engineers, and

entrepreneurs who understand the intersection between technology development and commercialization and who, through their entrepreneurial efforts, create start-up companies and jobs that will keep others like them living and working in the two states. To this end, each university will provide interdisciplinary support for student design teams that will work on a technological solution to a defined regional need, with early attention to feasibility studies and links to regional businesses and technology organizations and networks that can assist with the commercialization stage.

Specifically, each university partner will identify a faculty leader for the NMCPFI project. The faculty leader will be responsible for identifying the student design team for the institution (two students in Business/Marketing and two-three in science or engineering fields) and involving colleagues in providing experiences that integrate an understanding of technology development with that of technology commercialization. In addition, an advisor from one of the NMCPFI partner organizations will be identified to support the team. At the beginning of the project (Fall semester 2004), the NMCPFI Management Committee (see Management Plan) in consultation with regional organizations such as the U.S.-Mexico Joint Advisory Committee, will articulate a problem of concern to the region for which sustainable technological solutions are needed. Each university design team will then identify a component of the problem to address through development of new technology and related plans for commercialization.

The lead faculty member at each institution will be responsible for providing the design team members with the experiences and knowledge needed to support their work. In some cases, they may bring experts to campus from one of the partner organizations to offer a workshop or lecture that might be open to faculty and other students as appropriate. They will also link the design team with regional business and industry in fields related to the design project to help with the development of solutions, feasibility studies, and business plans that address commercial realities in the border region.

The student design teams will work on their solutions throughout the academic year, intensifying the time spent with advisors in laboratories over the summer. At the conclusion of the summer break, they will spend two weeks working together on one campus to finalize their solutions and share marketing knowledge and strategies.

During the following fall semester, when they have developed their technologies to the point that they can be presented, along with bench-scale demonstrations, feasibility studies, and business plans, the design teams will enter already existing regional competitions to expose their concepts to a broader audience. An example of such a competition is the WERC Environmental Design Contest held annually every spring semester at NMSU. This competition challenges student teams to provide solutions to environmental problems that have been submitted by private industry and governmental agencies. Students give oral presentations and demonstrations of their solutions in competition for cash awards and travel allowances. Approximately 100 representatives of academia, government, and industry serve as judges for the contest.

In addition to serving as advisors, partners in the NMCPFI will offer assistance to the design teams through making available, as feasible, their laboratory equipment and expertise. Moreover, all partners will be encouraged to attend competitions in which NMCPFI student solutions are entered and the Technology Showcase, which will serve as the culminating activity for the two-year project.

As the design teams refine their models according to feedback they receive from entering competitions and consulting with NMCPFI partners, they will also begin to contact enterprises and agencies with possible interest in supporting a start-up effort. In many cases, these contacts will be facilitated by NMCPFI partner organizations. By the end of the second year of the project, it is anticipated that several teams will have a technology ready for commercialization with a persuasive business plan and potential customers.

At least two opportunities will be provided each year for the design teams to visit other partner campuses. The Project Manager will communicate with all partners in the project to inform them of both individual and group opportunities for site visits, workshops, competitions, conferences, internships, and special events related to technology. Each partner institution of higher education will take responsibility

for hosting all the other partners once during the project for an ongoing technology-related fair or event, allowing all participants the opportunity to see other campuses and research facilities.

To expand the opportunities for student participation in dissemination of research, the partnership will take advantage of existing information-sharing opportunities, such as UACJ's Semana de Biología and Química. The partners will work together to identify multiple opportunities for the design teams to showcase their projects in front of audiences drawn from academia, business, and government. Face-to-face communication and interaction are more successful in technology transfer than relying only on published information. The National Technology Transfer Center (NTTC) states in its Technology Transfer Resource Guide, "Interaction is key to the process. Laboratory scientists and engineers must be involved in hands-on partnerships...and relationship-building practices" (NTTC, 1996).

Goal 2. Forming start-up companies. By focusing on interdisciplinary teams that combine knowledge of technology development and marketing and commercialization and by linking student design teams early in their work with business, industry, and high tech organizations in the region, NMCPFI expects to produce technologies from the student projects that will be commercialized through start-up companies. The technologies chosen for commercialization will focus on solutions to identified regional needs that have demonstrated a strong potential for sustainability through a feasibility study, business plan, and feedback from business and industry in related fields in the region. Each university's technology transfer office will provide the support for patent application, licensing agreements, and, as feasible, incubator space.

Goal 3. Bilingual Electronic Network. NMSU's Office of International Programs (OIP) will be responsible for establishing and maintaining a bilingual electronic Alliance for Technology (AT) network. A number of OIP staff are bilingual and capable of providing translation services during campus visits and competitions and for the electronic network and newsletter. The network, complemented by a quarterly newsletter, will keep all partners informed of project activities, internships, competitions, technology-related events, resources to support technology development and commercialization, and opportunities for technology partnering. Non-confidential summaries of technologies under development, both by the student design teams and by university faculty will be posted on the AT network to help disseminate emerging technology solutions to a broad audience. All NMCPFI partners will contribute to the content of the AT network.

Goal 4. Minority Recruitment. Goal 3 will be carried out through existing programs at each of the institutions for recruiting minorities into science, mathematics, engineering, and technology (SMET) fields. New Mexico has a statewide Alliance for Minority Participation, funded by NSF and headquartered at NMSU. Other programs linking NMSU and NMT in minority recruitment into SMET disciplines include New Mexico MESA (headquartered at NMT), which provides educational enrichment to pre-college students from historically under-represented ethnic groups and Regional Alliance for Science, Engineering, and Mathematics—Squared, which provides support to students with disabilities interested in attaining careers in SMET fields. In addition, the participating campuses each have local minority recruitment programs. At NMSU, these include Math and Science Educators for the Future (NASA), Career Opportunities in Mathematics, Engineering, Technology, and Science (NASA), Bridges to Engineering (NSF), Minority Engineering Transfer and Articulation (NSF), Enhancing Girl's Participation in SMET (NSF), Public Health Laboratory Sciences Training for Hispanic and Native American Students (NIH), Bridges to American Indian Students in Community Colleges (NIH), Minority Access to Research Careers (NIH), Support of Continuous Research Excellence (NIH), Computer Science Summer Camp for Native American Students (NSF), Minority Biomedical Research Support—Research Initiative for Scientific Enhancement (NIH), and Las Cruces PREP (NASA). NMSU is a Hispanic-Serving Institution and has a significant population of American Indian students, giving them a strong pool from which to draw students into the proposed project. NMT has an undergraduate enrollment of 19.3% Hispanic students and 7.3% other minorities.

Goal 5. Student Internships. The Project Manager will encourage the establishment of student internships at local or regional technology businesses and organizations. The internships will be designed

to offer students practical experience with technology commercialization and will last, at the most, one semester. Each student intern will have an advisor appointed from within the company or organization.

Goal 6. Integrating technology development and commercialization into existing science, engineering, and business programs. It is anticipated that the project activities will lead to sharing of resources to enable all institutions to create experiences within existing programs that integrate the technology and business elements of technology commercialization. NMSU is already addressing this integration through a proposal of the College of Business Administration and Economics and the College of Engineering to create a 2+3 BS/MBA program, which will allow high achieving students in undergraduate engineering programs to complete prerequisite coursework for the MBA program and to take up to four MBA courses during the senior year. The purpose of the program is to provide students with the expertise to understand and take part in the technical aspects of product development and production, the ability to use business decision-making tools and techniques, a solid foundation in business practices, and well-developed problem-solving and people skills. NMT offers an undergraduate Management of Technology major, which requires three semesters of Calculus, one year each of Physics, Chemistry, and another lab science, and an analytically oriented program of study within the NMT Management Department. Through distance education, NMSU and NMT will be able to share expertise and resources with each other and with the Mexican partners. A number of NMSU faculty in Engineering and Arts and Sciences have the capacity to teach in Spanish as well as English.

Goal 7. Technology Showcase. The initial Technology Showcase will constitute the culminating event for the two-year funded NMCPFI project and will take place on the NMSU campus. Thereafter, the Showcase will be hosted annually on a rotating basis by one of the partner universities. The Showcase provides an opportunity for the student design teams and others from the partner institutions with technology projects applicable to the border region to present their work to an audience drawn from the partner organizations, regional business and industry, high tech organizations, venture capitalists, foundations, and economic development agencies in New Mexico and Chihuahua. The presentations will focus both on the technologies and plans for commercialization and on lessons learned from the process. The lessons learned will become part of the AT network and will be disseminated through publications and presentations at business and academic conferences.

Rationale for the Partnership

All partner organizations included in the NMCPFI are necessary to achieve the goals of the project because they each have a role in helping move technology developed in the partner universities to the point of successful commercialization. They also all contribute to addressing the need for greater economic development in the New Mexico-Chihuahua border region. The institutions carry the primary burden for project implementation in appointing faculty leadership for the project, hosting technology-related events, including the Technology Showcase, maintaining communication among all affected parties, and ensuring coordination and effective use of the resources offered by the partners. The Government Laboratories (LANL, and SNL), the Physical Science Institute (a non-profit entity formed to facilitate long-term technology incubation, university-business partnerships, and jobs for New Mexico), and Technology Ventures Corporation offer expertise and training in technology transfer, possible internships for students, equipment that student design teams might access for product testing, and connections in the government, business, and industry sectors that might aid with the commercialization of sustainable technologies. CIAD and CIMAV provide similar resources on the Mexican side of the border. CIAD is a network of research centers in Chihuahua and throughout Mexico devoted to investigation of chemical, biological, and biomedical topics including food science, environmental management, and horticultural products. CIAD supports master's and doctoral level programs to help prepare future generations of scientists for Mexico. CIMAV conducts basic and applied research and development and technological innovation activities in materials science and the environment. CIMAV also prepares future scientists through joint graduate programs with state universities.

The New Mexico Economic Development Department, the Mesilla Valley Economic Development Alliance, and the Chihuahua Trade Office serve to connect project activities to larger regional economic development initiatives and priorities. The Asociación de la Industria Maquiladora de

Chihuahua, the Centro de Desarrollo de Proveedores, and the High Tech Consortium serve as high tech organizations willing to help promote NMCPFI activities to their constituencies, support the design teams' participation in competitions, and contribute assistance with planning the Technology Showcase. LaSys, Inc. will provide the knowledge and experience of a recent start-up company actively commercializing university research.

With support from the NSF Partnership for Innovations Program, the New Mexico-Chihuahua Innovation Partnership will be able to better support the later stages of technology commercialization, which AUTM argues is an area that should receive more emphasis at universities. By combining the resources of personnel and agencies knowledgeable in technology transfer and marketing, the Partnership will be able to carry out many of the strategies identified as most effective for making university research accessible to entrepreneurs, including strategies for seeking new inventions early, use of proven assessment techniques, focus on inventions deemed to have the most potential for success, surveying technology marketing organizations and professional societies for their potential to provide services, facilitating meetings and seminars for inventors and staff, studying success stories in other regions, and capitalizing on networking opportunities (Allan, 2001).

While economic development is a great need on both sides of the border, technological development and research capacity is well-established, offering rich opportunities for students and faculty to work on focused research problems and to develop an understanding of technology transfer and economic development on an international scale. In addition to the partner organizations, agencies, laboratories, and university departments that could host visiting students and faculty include the Center for Entrepreneurship (NMSU College of Business Administration and Economics), the Small Business Development Center at Doña Ana Branch Community College, Magdalena Ridge Observatory (NMT), the R.L. Golden Particle Astrophysics Laboratory, the Physical Science Laboratory (NMSU), the Manual Lujan, Jr. Space Tele-Engineering Program, the Center for High Performance Computing and Visualization (NMSU engineering), the Jornada Long-Term Ecological Research Programs (NMSU), the Jornada Experimental Station (NMSU, agriculture), the New Mexico Space Grant Consortium (NMSU), the Southwest Technology Development Institute (NMSU engineering), the New Mexico Water Resources Research Institute (statewide), and WERC—a Consortium for Environmental Education and Technology Development (NMSU). The NMSU College of Engineering also offers the Manufacturing Technology Engineering Center program, which includes a component on project design and development.

Sustainability

Once the project components are put in place and have demonstrated positive results for the commercialization of university research and economic development for the border region, each university will be responsible for sustaining its role in fielding student design teams, coordinating activities with regional partner organizations, hosting technology-related events for all the partnership to attend, and assisting with start-up companies using research developed by students and faculty. In addition, it is anticipated that institutionalized curricular enhancements will take place at all the institutions to integrate the study of technology development and commercialization. Programs developed at any one partner university may be shared with the other partners through distance education.

Student design teams will continue to participate in ongoing activities sponsored by the partners in the project. The existing minority recruitment programs for STEM disciplines will ensure that the project is able to serve a high percentage of minority students into the foreseeable future. Once established, the systems for coordination and communication among partner institutions, including the Alliance for Technology online network, will be maintained to promote institutionalized collaboration on research and technology transfer. Staff of the Office for the Vice Provost for International and U.S.-Mexico Border Programs will keep information current and will continue preparation of the electronic newsletter. In addition, the Office of the Vice Provost for Research will seek to institutionalize the position of Project Director and to locate additional funding for the annual Technology Showcase and for expansion of the program following the initial two years of implementation.

Broader Impacts Resulting from the Proposed Activities

The proposed project incorporates all of the broader impacts NSF is seeking in its grant-making programs. As explained above, the project will recruit women and minority (particularly Hispanic, Latino, Native American, and African American) students to become engaged in research projects mentored by faculty and volunteers from private enterprise and other technology-related organizations. Without the PFI program, these students representing underserved groups would not be able to access the support and educational experiences that are proposed here, largely for financial reasons. If students could not receive financial support for their work on technology development, feasibility studies, and business plans, they would have to seek paid work elsewhere. The exchanges and internships will give students an opportunity to experience research facilities and programs different from those offered on their home campuses. Research opportunities will also be integrated into the students' educational experiences through their participation in research conferences, both supported under the PFI program and sponsored under other auspices. The collaboration among students, faculty, and scientists from the partnership organizations will increase the likelihood of identifying additional opportunities for sharing resources to enhance development of new knowledge and international understanding.

The New Mexico-Chihuahua Partnership will build an infrastructure for sharing of information and research opportunities that does not currently exist. Moreover, the partnership activities involve several disciplines, supporting collaboration across colleges and programs. Collaboration with industry and government, as well as international partners, is essential to the accomplishment of project goals. In fact, a strong argument for sustaining the partnership beyond the period of NSF funding is that the project activities are focused on shared needs and interests. Each partner is under pressure to make progress toward the identified goals because they reflect local, state, and bi-national priorities.

Benefits to society include increased communication and information and resource sharing in the New Mexico-Chihuahua border region leading to establishment of small businesses that will commercialize research developed at the universities. Moreover, the project focuses on building better understanding of technology transfer among students and faculty at the participating universities, none of which currently participates very actively in the research commercialization enterprise. Coordination of the technology transfer process with community and state agencies will contribute to economic development, where the creation of new high-tech businesses will result in new jobs and will keep more of the partner universities' graduates in the region.

All the partner institutions engage in research that provides answers to regional as well as national needs in the areas of biomedicine, health, agriculture, and engineering. For example, research by the partner institutions in plant pathologies should lead to products and inventions that will improve crops in semi-arid regions, not only in the U.S.-Mexico border region, but also in other parts of the world. This project will sharpen that focus, by having the members of the Management Committee identify each year a specific regional problem for student projects to address. Thus, the sharing of research activities across the partner universities and research labs will advance solutions to problems of concern on both sides of the border, and indeed in other parts of the world, resulting in benefits that extend well beyond the participating institutions.

Dissemination Plan

Project outcomes will be disseminated through the bilingual Alliance for Technology network and the electronic newsletter, and through presentations of students, faculty researchers, and entrepreneurs at local, state, national, and international competitions, showcases, and conferences. Participants will be able to showcase their research and commercialization strategies at such venues as the annual PFI conference, NMT's Mechatronics Conference, the UACJ Semanas de Biología y Química, and at the participating institutions' engineering and environmental design contests (such as the WERC contest at NMSU). Additionally, participants can participate in conferences and publish in journals of professional associations such as the American Society for Engineering Education, the National Action Council for Minorities in Engineering, the Society for Advancement of Chicanos and Native Americans in Science, the National Association for Research in Science, the Pan-American Association for

Biochemistry and Molecular Biology, the American Society for Biochemistry and Molecular Biology, the Sociedad Mexicana de Bioquímica, the American Society for Gravitational and Space Biology, the American Society of Agricultural Engineers, and the American Society of Horticultural Science.